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Pennsylvania Weeds

Their Control and Eradication

By E. M. Gress, Ph. D.
State Botanist

Wild Carrot

J. HANSELL FRENCH, *Secretary of Agriculture*
R. H. BELL, *Director, Bureau of Plant Industry*

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POINTERS ON WEED CONTROL

Sow clean seed. If you are in doubt about the purity of the seed, have a sample analyzed by the Pennsylvania Department of Agriculture.

Allow no weeds to mature seeds.

Starve underground portions of biennial and perennial weeds by keeping all leafy parts cut off close to the ground.

Rotate crops. Clean cultivation will assist greatly in keeping the farm clean of most weeds.

Follow out a definite method of attack on weeds and do not stop until every evidence of the weed is gone.

Keep weeds out of fence rows and waste places. These are common sources of infestation for adjoining cultivated areas.

A State law (Act 58—1923) provides for the cutting of Canada thistle and chicory wherever found in Pennsylvania before such weeds go to seed. Farmers should observe this law and insist upon its observance by others.

Get acquainted with strange weeds. One weed can be the start of a real menace. The State Department of Agriculture will identify any weeds sent in by farmers.

Pennsylvania Weeds

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CONTENTS

Page
Weeds Are Costly 3
How Weeds Cause Loss 3
Survey Reveals Worst Weeds 4
Classes of Weeds 5
How to Control Weeds 6
Prevention Cheaper Than Eradication 7
Chemicals in Weed Control 8
Chlorates 9
Applying Chlorates 9
Iron Sulphate 10
Copper Sulphate 10
Sulphuric Acid 10
Other Herbicides 11
Get Acquainted With Strange Weeds 11
Seed Law Helpful in Weed Control 11
Canada Thistle 12

Page
Plantain 14
Chicory 16
False Flax 18
Field Pepper Grass 19
Horse Nettle 20
Garlic 22
Winter Cress 25
Cockle 25
Perennial or Field Sow Thistle 27
Quack Grass 28
Clover Dodder 30
Morning Glory 32
Hawkweeds 33
Ox-Eye Daisy 35
Wild Carrot 37
Wild Mustard 38

WEEDS ARE COSTLY

Weeds cost an estimated annual loss of $2 per tillable acre in Pennsylvania. A questionnaire sent to county agents in Pennsylvania asked them to estimate the loss caused by weeds. In reply to this question, the average of the estimate of the annual loss for each acre of tillable land was $2.64. In the three agricultural provinces of Canada, the annual loss for each acre of tillable land has been estimated at $2. Therefore, it seems that a $2 annual loss per acre would be a fair and conservative estimate in Pennsylvania.

Since Pennsylvania has approximately twelve million acres of tillable land, the total loss from weeds would aggregate about twenty-four million dollars, which is approximately $2 for each person living in the State. Distributed among nearly two hundred thousand farms in Pennsylvania, the average loss per farm amounts to about one hundred and twenty dollars per year. In other words, the net profit on each farm is reduced on the average one hundred and twenty dollars per year by weed growth. This is one form of tax that can be reduced greatly. Controlling such noxious weeds as Canada thistle, quack grass, wild carrot, plantain, garlic, horse nettle, morning glory, and such other weeds as are described in detail in this bulletin, will do much to reduce the loss from weeds to a minimum.

HOW WEEDS CAUSE LOSS

Weeds increase labor: in the preparation of soil for planting; in cultivating the crops; in harvesting the crops; in preparing produce for market.

Weeds increase wear and tear on machinery.

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[1] Acknowledgments: Figs. 2, 3, 4, 5, 11, 12, 13, 14, 15, and 17 from Farm Weeds of Canada, 1909; Figs. 6, 7, 8, and 9 from Michigan Weeds, 1911.

Weeds decrease the yield: by shading and crowding out crop plants; by using moisture and food material needed by the crop plants and by harboring insects and plant diseases which destroy crop plants.

Weeds decrease the value of farm products: by dockage on wheat and other farm products from such weeds as garlic, thistle, etc.; by preventing the proper drying of grain and hay, thereby reducing the quality and price.

Weeds reduce the market value of the farm.

Live stock is lost each year by poisonous and injurious weeds.

Weeds detract from the appearance of the farm and community and thus lower the aesthetic tone of the people and the market value of the farms in th neighborhood.

SURVEY REVEALS WORST WEEDS

The county farm agents of the State were asked to name the fifteen worst weeds in their various counties. Out of replies from twenty-four agents all named Canada thistle; twenty named quack grass; fourteen named wild carrot; and thirteen named wild mustard. The worst weeds as checked by the various counties which took part in the survey are shown in Table I. (Survey in 1927.)

TABLE I

Results of Survey in Twenty-four Pennsylvania Counties Showing Worst Weeds

Name of Weed	Name of County																								
	Bedford	Berks	Bradford	Bucks	Cambria	Clinton	Crawford	Cumberland	Delaware	Greene	Huntingdon	Lancaster	Lebanon	Lehigh	Monroe	Montgomery	Northumberland	Perry	Schuylkill	Union	Warren	Wayne	Westmoreland	Wyoming	TOTAL
Canada Thistle	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
Quack Grass		X	X	X	X	X	X	X	X		X	X	X	X	X		X		X	X	X	X	X	X	20
Wild Carrot	X	X		X	X	X	X					X		X	X	X	X	X		X		X			14
Wild Mustard			X	X			X	X					X	X	X	X				X	X	X	X	X	13
Ragweed		X		X	X		X		X	X	X	X		X	X		X	X						X	13
Plantain		X		X		X				X		X	X	X	X		X				X	X	X		12
Chicory		X			X			X			X	X	X	X		X	X	X		X					11
Daisy	X	X		X	X					X					X	X				X	X	X	X		11
Garlic		X		X		X		X	X		X	X	X					X		X			X		11
Morning Glory				X		X			X	X			X		X	X			X		X	X		X	11
Dock		X		X		X			X	X			X			X				X		X	X		10
Cockle		X			X	X		X			X	X					X			X	X				9
Horse Nettle	X			X				X	X		X					X		X			X		X		9
Bindweed		X				X			X			X		X	X		X								7
Smartweed				X		X			X					X	X	X						X			7
Chickweed		X				X			X	X					X	X							X		7
Hawkweed					X		X								X						X	X		X	6
White Top							X	X	X	X	X										X				6
Dodder		X									X	X	X			X									5
Pigweed						X			X			X				X							X		5
Crab Grass				X					X			X			X	X				X					6
Foxtail		X						X					X									X	X		5
Milkweed		X											X	X								X			4
Sow-thistle												X	X	X						X					4
Burdock										X			X	X						X					4
Dandelion											X			X			X					X			4
Poison Ivy				X						X													X		3
Other Weeds[1]		1		1	3	2		2	1	1	2	2	1	1		1				3	4	1	3	1	30

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[1] Other weeds include nutgrass, mullein, sorrel, galinsoga, lamb's quarters, pepper grass, yarrow, shepherd's purse, wild parsnip, artichoke, buttercup, five-finger, night-shade, toad flax, bracken fern, poison hemlock, live-forever, false dandelion, iron weed, goldenrod, cocklebur and cat tail.

It will be noticed that a weed reported from one section of the State may not be given for some other section. This, of course, would be expected in a State with such varied soil and climate conditions and with such a diversified agriculture.

CLASSES OF WEEDS

As to the length of life weeds are classified as annuals, biennials, and perennials.

Annual plants are those that live only one year. The annual plant grows from a seed and produces flowers and seeds the same season. The entire plant, including the root, then dies. Annual plants may be divided into two classes: summer annuals and winter annuals. The summer annual begins growth from a seed in the spring and matures seeds in the summer or fall. The entire plant then dies. The **winter annual** begins growth from a seed in the fall. Only a small plant is produced before winter begins. This small plant lives over winter and beginning growth in the spring produces flowers and seeds during the summer. It then dies. By many both kinds of annuals are included in the term "annual plants."

Examples of annual weeds are: crab grass (*Syntherisma sanguinalis* Nash), corncockle (*Agrostemma githago* L.), pepper grass (*Lepidium* spp.), wild mustard (*Brassica* spp.), tumbling mustard (*Sisymbrium altissimum* L.), dodder (*Cuscuta* spp.), white top (*Erigeron annuus.*), common ragweed (*Ambrosia Artemisiifolia* L.), prickley lettuce (*Lactuca scariola* L.).

Biennial plants are plants that live for two years. Biennial plants begin growth from the seed in the spring and produce a leafy plant which manufactures food and stores it up in the root during the first season but does not produce flowers and seeds. These roots live over winter and the next spring begin growth and produce a plant which blooms and forms seeds. After maturing the seeds the biennial plant, like the annual, dies roots and all. Examples of biennial weeds are: wild carrot (*Daucus carota* L.), vipers bugloss (*Echium vulgare* L.), great burdock (*Arctium lappa* L.), bull thistle (*Cirsium lanceolatum* Hill), common and moth mullein (*Verbascum* spp.).

Perennial plants are plants that live from year to year. The stalks of many perennials die down to the ground in the fall but the roots live from year to year producing a new stalk each season. The roots of some perennial plants penetrate the soil so deep and are so persistent that it makes it very difficult to eradicate them when once they become well established.

Examples of perennial weeds are: quack grass (*Agropyron repens* Beauv.), garlic (*allium* spp.), dock (*Rumex* spp.), bladder campion (*Silene latifolia*), morning glory, (*Ipomoea pandurata*), bindweed (*Convolvulus* spp.), horse nettle (*Solanum carolinense* L.), broad-leaved and narrow-leaved plantain (*Plantago* spp.), yarrow (*Achillea millefolium* L.), ox-eye daisy (*Chrysanthemum leucanthemum* L.), Canada thistle (*Cirsium arvense* Scop.), chicory (*Cichorium intybus* L.), dandelion

(*Taraxicum officinale* Weber), field sow thistle (*Sonchus arvensis* L.), orange hawkweed, devil's paint brush (*Hieracium aurantiacum* L.), field hawkweed, king devil (*Hieracium pratense* Tausch).

HOW TO CONTROL WEEDS

Annuals and Biennials. In order to control or eradicate weeds it is necessary to understand their habits of growth and reproduction. Since annual and biennial plants produce seeds only once and then die roots and all, it is evident that reseeding must be prevented. Any method of attack that will prevent the maturing of seeds and the introduction of seeds into the soil will control annual and biennial weeds. Allowing weeds to mature seeds and sowing unclean seed are the two chief means by which seeds are introduced into the soil. Both of these can be, but frequently are not, controlled by the farmer.

Thorough cultivation throughout the season of such a crop as corn or potatoes will kill annual and biennial weeds. It must be remembered, however, that viable seeds of many plants remain in the soil for several years. The germination of these seeds will, of course, produce a subsequent growth of weeds that should be destroyed before they produce a new crop of seed.

Often the farmer, for want of time, neglects the cutting of weeds along the fences, by the roadside, in the ditch, or in waste places. These weeds grow to maturity, and by the many agencies of distribution the seeds are carried into the field only to begin a new crop of weeds and to discourage the farmer in his effort to eradicate the pests.

Perennials. Perennial plants are propagated by seeds and by underground parts. As with annuals and biennials seed production and seed introduction must be prevented. In addition to this the underground part must be destroyed. This may be accomplished in two ways: by removal and by starvation. A combination of the two ways is usually practiced.

It should be remembered that the underground organ which propagates the perennial plant, whether it be a bulb, a tuber, a fleshy root, a rootstock or some other organ, has received its supply of food from the leaves. Therefore, any method of attack that will prevent leaf growth will cut off the food supply from the underground propagating organ.

For example, the Canada thistle grows from a deep cord-like rootstock which it is really impossible to remove completely. The food in these rootstocks has been manufactured in the leaves of the Canada thistle plant. If the leafy plant is cut off close to the ground, what happens? Other plants will soon grow up around the cut-off stump. These new plants are drawing on the supply of food which has been stored up in the rootstock. Now if these new plants are allowed to grow and form leaves the food supply in the rootstocks will be increased, but on the other hands, if these new plants are in turn cut off before they begin to make food the food supply in the rootstock will be reduced. Therefore if the Canada thistle is cut off close to the ground at regular, short intervals so that no leaf surface may be formed, the underground part will finally die of starvation and the pest will be eradicated. If this method be followed persistently for one season, at most two, the Canada thistle or any other noxious weed can be exterminated.

The work must be thoroughly done with persistence and patience and without ceasing until 100 per cent of the weed is eradicated. Too often the work is stopped when eighty per cent to ninety per cent of the plant is destroyed, and in a few years the weed is as bad as ever. The farmer then says, "There is no use in trying, it can't be done," when the very fact that the destruction of eighty or ninety per cent of the weed proves that his method was based on the right principle, the only fault being that he stopped too soon.

Very bad patches of noxious weeds should be dug up or ploughed and left in this bare, fallow condition through the entire season. The patch should be kept clean of all vegetation by digging or cultivation every week, or oftener if necessary, throughout the season. Continue in this way for more than one season if necessary or until every trace of the weed is gone.

In most cases a crop of corn, potatoes, or some other crop that admits of clean cultivation throughout the season, may be raised at the same time that the weed is being killed. Keep in mind, however, that the chief object is the eradication of the weed, while raising of the crop is secondary. Too frequently these two objects are reversed and the farmer wonders why the eradication of the weed was not accomplished, or thinks it is an impossibility.

PREVENTION CHEAPER THAN ERADICATION

Prevention is the best and cheapest method of weed control. Many farmers give no attention to a weed until it becomes very annoying and causes a marked financial loss.

The most noxious weeds in the State can be kept off the farm by vigilance, even if they are on a neighboring farm. The seeds of such weeds as horse nettle, quack grass, bindweed, morning glory, garlic, dodder, mustard, chicory, buckhorn and others are not carried by wind. Canada thistle seeds are wind carried, but Pennsylvania has a law (Act 58-1923) which provides for the destruction and the prevention of the spread of Canada thistle and chicory. Anyone upon written notice can force the constable or supervisor to enforce this law.

Section 1 of this act reads in part,

> "it shall be the duty of every person or persons, and of every corporation holding land or lands in any county or counties of this Commonwealth, either by lease or otherwise, on which Canada thistles or . . . chicory may be growing, to cut the same so as to prevent such weeds from going to seed."

This section also provides for a fine of fifteen dollars in case the law is violated.

Section 3 reads,

> "It shall be the duty of the supervisor or supervisors of the public roads or highways in every township or district as aforesaid, to cut and destroy in the same manner all such (Canada thistles or) weeds on or along such roads, in case of unseated or mountain lands, whenever it shall come to the knowledge of either the supervisor or constable of the existence of any such (Canada thistles or) weeds thereon, it shall be his duty to notify the owner

> or owners, or agents of said lands in writing, giving ten days' notice to cut and destroy the same as aforesaid, and upon failure to comply at the end of ten days, such officer or any person or persons employed by him, shall proceed in the manner hereinbefore provided, with like fees and compensation, and if any such constable or supervisor shall neglect or refuse to perform his duties as prescribed by this act, he shall be liable to a fine of ten dollars, the same to be sued for and recovered as aforesaid, by the party or parties aggrieved or about to be injured by such neglect or refusal."

The introduction of noxious weeds into a neighborhood can be traced in almost every case to the sowing of unclean seed. Rarely will birds carry the seeds long distances. Occasionally they may be carried by railroad trains or automobile trucks or some other less likely agent.

When weeds have been introduced into the community it is very easy to have them carried from one farm to another by threshing macines, by the exchange of hay, grain and seeds of various kinds, by careless disposal of screenings, by manure and many other agencies. The first appearance, however, of a noxious weed on any farm is usually in a very limited quantity—probably only a few plants—except where fields have been seeded with unclean seed.

If the farmer is on the alert and is observant and vigilant these few plants will be eradicated on first appearance, or if he has been careless in sowing seeds that produced a crop of noxious weeds he will immediately take steps to eradicate the weed before it has a chance to go to seed or to become well established. Farming such a field in a cultivated crop, as corn or potatoes, before the soil has become polluted with seeds or before the plant has established deep underground roots or rootstocks, will, if carefully done, eradicate the weed in a single season.

CHEMICALS IN WEED CONTROL

Chemicals (herbicides) have been used in weed control for many years. Perhaps more progress has been made in their use during the last twenty-five years than in any previous period of equal length.

There are so many controlling factors involved in the use of herbicides that their effectiveness is not always assured. Among these factors are weather conditions. If a herbicide controls weeds by contact with the surface of the leaves, rain immediately following the application, may wash the chemical off before it has had time to injure the plant. On the other hand, if the weather is too dry, the chemical may crystalize on the leaf and fall off before the weed has been injured.

The nature of the plant and soil conditions are other factors controlling the use of herbicides. The soil is often rendered unfit for the growth of a crop for too long a period, thus making the use of herbicides impractical. Sometimes desirable plants are injured. In general, the use of chemicals is more expensive than cultivation methods. On the other hand, there are places where cultivation methods cannot be used. Along highways and railroads, in tennis courts and many other places herbicides are most practical and economical.

Among the chemicals in use as herbicides are: the chlorates-sodium, potassium, magnesium, and calcium; sodium arsenite, iron sulphate (copperas or green vitriol), copper sulphate (blue vitriol), zinc sulphate, ammonium sulphate, sulfuric acid, ammonium thiocyanate, carbon bisulfide, sodium chloride (common salt), ethylene oxide, gasoline, kerosene, and other oils.

CHLORATES*

The chlorates are the most effective and most extensively used today. Much is now known about chlorates as herbicides. However, continued experimental work is needed to obtain more definite information as to the time, methods, and other details of their use. Among the chlorates in use, the most effective is sodium chlorate, which, however, becomes quite inflammable when it comes in contact with wood, clothing, hay or any kind of organic material.

The fire hazard is reduced when the sodium chlorate is mixed with calcium chloride. Therefore, many of the chlorate herbicides on the market are mixtures which can be handled with greater safety than the pure sodium chlorate. Chlorates are inflammable but not explosive except when mixed with dust, therefore, those who use chlorates as herbicides, should keep in mind the fire hazard, and not allow them to accumulate on clothing or machinery, nor to become mixed with sulphur, dust or any kind of organic material.

There is, on record, a case of a man being burned to death before he could remove his rapidly-burning clothing on which chlorate became encrusted. It is also reported that intense sunshine set on fire a workman's clothing on which chlorate solution had dried. Another workman's shoes encrusted with the dried chlorate were set on fire by a spark caused when a nail in the shoes came in contact with the hard concrete sidewalk.

APPLYING CHLORATES

The application of sodium chlorate depends upon many factors. Among these are—the kind of weed, the condition of the weeds at the time the application is made and the time of year when application is made. It may be applied by broadcasting the dry salt at the rate of 200 to 300 pounds per acre (an acre contains 43,560 square feet). Some authorities recommend a much heavier first application, which may eliminate retreatments. In solution, dissolve at the rate of one pound to a gallon of water and apply at about the same rate per acre. Chlorates may be applied at any time of year; the best time, however, is July, August and late fall—about November. Retreatments, if necessary, for areas treated the previous summer, may be made in the spring as soon as the frost is out of the ground.

Some recommend the application when the weeds are about six inches high. If the weeds are much larger, they should be cut, before the spray is applied. Additional applications may be necessary for deep-rooted perennial plants. Usually the quantity used may be reduced after the first application.

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* Special Bulletin 183, "Perennial Weeds and Their Control," University of Minnesota, St. Paul, Minnesota, 1937, gives detailed information on the use of chlorates in Minnesota.

The chlorate, when applied at the rate recommended, will kill all plants with which it comes in contact, and a crop cannot be raised during the season. The above recommendations are based upon *sodium chlorate.* Other chlorates may be used, but they are not quite so effective and should, therefore, be used a little stronger.

The chlorates are not extremely poisonous to livestock, but large quantities are dangerous. Therefore, animals should not be allowed to graze upon recently sprayed plants. If animals are salt-hungry they will eat sodium chlorate ravenously, therefore, do not allow them access to stored quantities of chlorate.

Chlorates are usually sold in metal drums or kegs by dealers who handle agricultural supplies. The price varies considerably. Usually it is about eight to ten cents a pound at the factory when purchased in quantities of 100 pounds or more. Retail prices are higher especially for smaller quantities.

IRON SULPHATE

Iron sulphate has been known as a selective herbicide for many years. It is cheap, costing about a cent a pound. Iron sulphate is used to kill certain kinds of mustards in grain fields. It is used as a spray in strength of 100 pounds dissolved in fifty gallons of water, which is sufficient to spray one acre. The solution should be strained and applied in the form of a fine mist with a power sprayer. The spray should be applied before the grain begins to head or the mustards to bloom. Later the grain may be injured and the mustard not killed. Best results are obtained if the application is made on a cloudy day. Rain following the application too soon will wash the material off before the mustard is damaged. If the sun is shining and it is too dry the material will dry and form crystals, which may drop off before the weed is damaged.

COPPER SULPHATE

Copper sulphate is used much like the iron sulphate, but in a much weaker solution. Twelve pounds are dissolved in fifty gallons of water. From fifty to one hundred gallons of this is sufficient to spray one acre.

SULPHURIC ACID

This is a very active herbicide which is usually applied in a three to ten per cent solution. Sulphuric acid will burn the skin and clothing and must be handled with care. *Keep it away from children.* Never pour water into sulphuric acid, intense heat is generated. *The acid must be poured slowly into water* in a vessel which will not break by becoming heated, preferably in a wooden vessel. The acid even in dilute solution must not be left stand in metal vessels. It should be stored in glass containers.

OTHER HERBICIDES

If it is desired to use other herbicides mentioned in this bulletin, other sources of information should be consulted. Walter Conrad Muenscher, in his book entitled "Weeds," published by the MacMillan Company of New York in 1935, gives very complete information and many references on the use of herbicides.

GET ACQUAINTED WITH STRANGE WEEDS

A careful farmer is well acquainted with the weeds that grow on his farm. He may not know the scientific name or even the common name, but he knows something about its method of propagation and its general habits. He ordinarily recognizes a stranger, but too often he pays no attention to it until it becomes an obnoxious trespasser or intruder.

As soon as a strange weed makes it appearance, the farmer should make its acquaintance. If he is unable to find out for himself any information about the plant he should send a specimen to the Department of Agriculture at Harrisburg or to some other place where information on the habits, control and eradication of the plant may be obtained.

SEED LAW HELPFUL IN WEED CONTROL

Value of Clean Farm Seeds. Perhaps the greatest loss to the farmer is caused by the sowing of seeds that contain other seeds, particularly those of noxious weeds.

A noxious weed seed which causes a dockage on wheat is that of cockle, one to two per cent causing a discount of three cents per bushel while three to five per cent may cause as much as eleven cents discount. Such noxious weed seeds are taxing the farmers heavily, and in addition are polluting their farms with noxious weeds which will cause additional losses.

These losses due to impure seeds are not confined to one kind of crop. The seed laboratory of the Pennsylvania Department of Agriculture analyzed a sample of red clover seed which a seed firm purchased from a farmer in southeastern Pennsylvania, and which showed more than fifty per cent weed seeds. There were present forty-six per cent of buckhorn or narrow-leaved plantain seeds, while the remaining weed seeds were made up of many other noxious weeds. The farmer who sold this clover seed was quite indignant because he received less than fifty per cent of the market price for it; nor did he sell his entire crop, but kept enough for himself and some of the neighbors who were willing to buy on price rather than quality. The injury from sowing such worthless stuff cannot be determined, but the loss to the farmer is enormous.

Purposes of the Seed Law. The purpose of the Pennsylvania Seed Law is two-fold: first, to insure a supply of clean seed free from weeds for farmers' use; second, to protect the honest seedsmen and farmers against the practices of dishonest and careless seedsmen. This is accomplished by requiring that all seeds sold in certain quantities for seeding purposes shall bear a tag or label giving information as to the purity, germination, and the nature and kind of impurities contained. The State Department of Agriculture is authorized to collect samples of seed offered for sale for purposes of analysis to determine whether or not the seed supply complies with the information given on the label. Likewise, the Secretary of Agriculture is authorized to publish any and all information obtained from tests and analyses made under the provisions of the seed law. This published report may include the names and addresses of any persons who have sold, offered for sale or otherwise exposed for sale any agricultural seeds so tested or analyzed. While this protection is made possible by the law, it is obviously impossible for the State to force the farmers or seedsmen to accept that protection. Adequate protection can result only from the closest cooperation of farmers and seed dealers with the Pennsylvania Department of Agriculture.

What Farmers Should Do. First, buy from a reliable seed firm located within the State of Pennsylvania. Farmers who buy from mail order houses or other retailers outside the State can secure no protection under the Pennsylvania law. Second, demand a statement of the official analysis of the seed offered for sale and do not buy unless the dealer will furnish this statement.

What Retail Seedsmen Should Do. The retail seedsman should always demand an analysis from the wholesaler. Every bag of seed should have a tag firmly attached showing the full analysis as required by the Pennsylvania Seed Law. He should keep a copy of this analysis, and, if possible, a sample of the seed. If the retailer follows good business practices and demands a guaranteed analysis, he can shift the responsibility to the wholesaler in case complaint is made of the seed. Both retailer and wholesaler within the State are responsible for any violation of the law but if the retailer is vigilant and careful, he will not buy or accept seed from wholesalers who do not follow the practice of having seed properly tested as required by law.

Report Violators of Seed Law. Both farmers and retailers will find it to their advantage to report to the Bureau of Plant Industry, Pennsylvania Department of Agriculture, any seedsman who fails to properly tag supplies of seed giving purity and germination, or any dealer who continues the practice of selling a poor grade of seed.

The most troublesome and destructive weeds prevalent in Pennsylvania are described in the following pages.

CANADA THISTLE

(*Cirsium arvense* Scop.)

Canada thistle (Fig. 1) is one of the worst weeds found in Pennsylvania. It is known locally by many other names but most of our Pennsylvania citizens know it by the name of "Canada thistle." It is an introduced perennial which is propagated by both seeds and creeping roots. It blooms from June to August and produces seeds from July to September.

Canada thistle grows under various soil conditions but thrives best on rich, loamy, moist soil. It is found from Newfoundland to British Columbia and southward over the northern half of the United States from the Atlantic to the Pacific. There is little danger of its extending farther south than to a line extending from southern Virginia westward to the Pacific Ocean, since the climatic conditions of the south are not favorable to its growth.

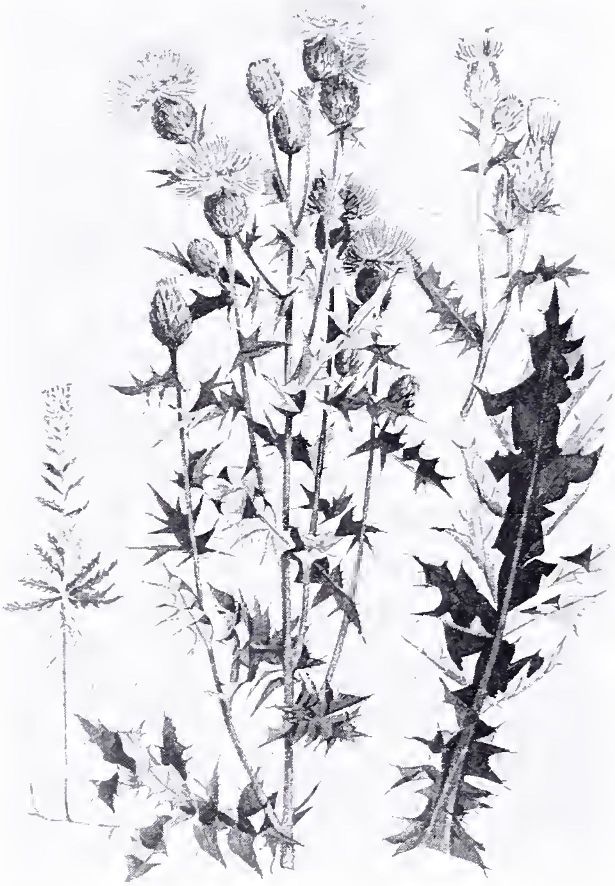

Fig. 1. Canada Thistle.

Distinguishing Characters. There are several forms of Canada thistle. The difference is found chiefly in degree of lobing of the leaf, also in the hairiness and spininess and the height of the plants. One of the chief distinguishing characters of the plant is the light yellow or nearly white running roots. These are about one-fourth inch in diameter and may be found fifteen inches or more underneath the surface. They run horizontally with the surface, and have been known to grow eighteen feet long. New plants spring from these roots at different times throughout the season. The stems are one to four feet tall, erect, slender, grooved and slightly woody. The leaves are sessile and slightly clasping. They are uneven or ruffled and the margins are irregularly toothed and very spiny. The leaves, however, vary considerably and on one variety are practically free from spines. The small purplish flower heads are about a half inch in diameter. Some plants bear flowers without pistils. These, of course, never produce seeds. The seeds, which are borne only on the perfect-flowered plant are about one-eighth inch long, smooth, brown, and bear a white tuft of hairs, which aids in their distribution by the wind.

Control. In order to eradicate the plant, the long, creeping roots must be starved. This can be done by removal of the top growth. All the food in these roots has been made in the leaves; therefore, stop leaf growth and starve the roots. Clean cultivation is one of the best methods of control. Plow the soil about the time the thistle is in bloom. Cultivate the soil during the remainder of the season with a sweep or knife type of cultivator. Begin cultivation again early in the spring and prepare a good seed bed. Plant the field in corn, using the check row system, if practicable. Cultivate the corn well during the summer to prevent the development of young thistle plants. Use the hoe to keep down the plants not destroyed by the cultivator. As soon as the corn is cut begin cultivation again. Prepare a good seed bed and sow it to rye. Plow the rye under the following spring and plant again to corn. Two years of such careful treatment should eradicate the plant. If necessary, however, repeat the treatment for another year. Vigilance, proper implements and strict adherence to a carefully planned method of attack is the price that one must pay for the eradication of any troublesome weed.

In small patches or areas the plant may be killed by persistent and frequent cutting close to the ground for at least two seasons, so that leaves may not develop. The same result may be accomplished by the use of hot brine, caustic soda, or kerosine. The chlorates have proved very effective in the eradication of this pest. For method see page 9.

PLANTAIN

(*Plantago* spp.)

There are several species of plantain which cause trouble. They include: 1. common, broad-leaved plantain (*Plantago major* L.); 2. red-stemmed plantain (*Plantago rugelii* Dcne.); 3. buckhorn or narrow-leaved plantain (*Plantago lanceolata* L.) (Fig. 2). There are several other species which do not cause much trouble as a weed.

The three species given above are all perennial plants which are propagated only by seeds. The roots live from year to year producing a new plant each year, but the plant does not spread from the roots.

The seeds of plantain are very commonly found in grass and clover seeds and are in this way widely distributed. The seeds become sticky with a coat of mucilage when wet, which assists in their distribution by birds and other agencies. The narrow-leaved plantain begins to bloom and form seeds early in the summer and continues throughout the summer and fall. The other two do not begin to bloom so early but continue throughout the remainder of the summer. All of these plantains have a wide range of distribution, being found practically throughout North America except in the far north. The narrow-leaved plaintain or buckhorn is the most troublesome to farmers and while many farmers do not give it much attention, it nevertheless is causing a financial loss to them by using moisture and nutriment that should be used by the crop plants to produce a better yield. It also crowds out many crop plants in this way producing a poor stand and, thereby, a reduced yield.

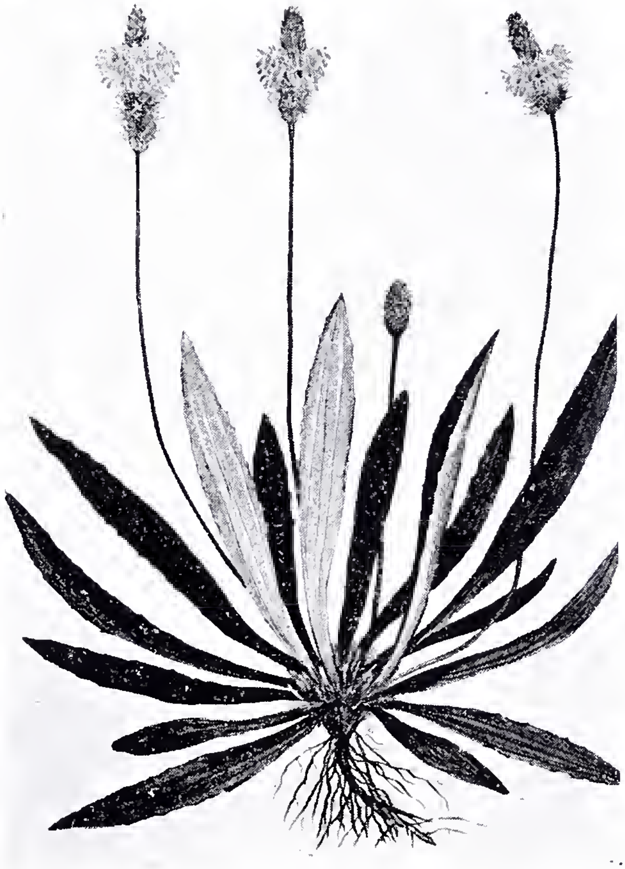

Fig. 2. Buckhorn Plantain.

Probably no other plants cause a more unsightly lawn than plantains. The lawn mower will not cut the rosette of leaves which lies close to the ground, nor will it cut the tough wiry flower stalk.

Eradication and Control. Sowing clean seed will prevent an infestation of this weed. It cannot be controlled by spraying, therefore only mechanical methods will eradicate it. The seeds are long-lived and if the soil becomes polluted with them one cannot expect to eradicate the plant in a short time.

Seed formation must be prevented. Any method that will accomplish this will be effective. In large areas, clean cultivation of such a crop as corn or potatoes is no doubt the best way to begin the fight.

In one year, if the hoe is used to kill those plants not destroyed by the cultivator, almost complete eradication may be accomplished. The field should have been plowed in the fall previous to planting the corn in the spring. When the corn is cut the ground should be well prepared and sowed in wheat or rye, preferably the latter. If the weed has not been destroyed, which can be noticed the following spring, the rye can be plowed under and corn planted the second season. This treatment will eradicate not only plantain, but, if well done, such weeds as Canada thistle, quack grass, and garlic.

Control in Lawns. In lawns, plantains and dandelions or any plant that grows in rosettes close to the surface may be killed by injecting well down into the center of the rosette, with a sharp pointed oil can, some carbolic acid, kerosene or gasoline, or by dipping a sharp ice pick into a bottle of concentrated sulfuric acid and penetrating it deeply into the center of the rosette. Enough sulfuric acid will be injected into the crown and root to kill the plant. **Sulfuric acid is very strong and will eat clothing or a metallic vessel and will burn the skin, therefore handle it with care and keep it away from children. Carbolic acid is also very poisonous.**

The plants may be destroyed by cutting them off below the surface with a sharp spud or instrument of some kind. If enough of the root is not cut off it may produce another plant, which, of course must be removed. If the lawn is badly infested it may be necessary to dig it up and re-seed it. Plantain alone will rarely make it necessary to do this. The addition of a good fertilizer and the sowing of good lawn seed in the fall and in the early spring will keep the turf renewed and will be a great help in keeping the weeds down.

CHICORY

(*Cichorium Intybus* L.)

Chicory (Fig. 3) is an introduced perennial which has become a noxious weed in parts of Pennsylvania, particularly in the southeastern section of the State. It begins to bloom in July and continues blooming and maturing of seed through the summer. It is propagated only by seed, by which means it is likely to spread rapidly.

Distinguishing Characters. Stem one to four feet high, hollow, hard and rather woody with age, containing milky and somewhat bitter juice. Roots are long, perennial, tap roots which are used as an adulterant and substitute for coffee. The lower leaves are in rosettes and resemble somewhat those of the dandelion. The stem leaves are smaller, usually entire, clasping and auricled at the base. The flowers are bright blue in color, about one and one-half inches across, attached to the naked stem without any flower stalk, and usually close by noon. The blue rays are five-toothed at the end. The bracts of the involucre are green and in two rows, the outer one being shorter and more spreading than the inner. The seeds (achenes) are usually mottled brown, about one-eighth inch long, and contain a fringe of hair-like scales at one end.

Control. If not too abundant the plant may be hand-pulled when the ground is wet and soft. If there are too many plants to hand-pull use a spud or some other implement, cutting each plant an inch or two below the surface of the ground before the seeds ripen. A little salt or chlorate applied to each cut-off root will assist in killing it. If too abundant for either of the above methods then use "rotation of crop" method. Plow the ground in the fall. After preparing a good seed bed in the spring, plant to corn, using the check-row system if possible. Thoroughly cultivate during the entire summer, being careful not to allow any plants to mature seed in the field or along the fences. If the work has been thoroughly done, one season should eradicate the weed. If necessary repeat the process another season. Two seasons should certainly accomplish the result.

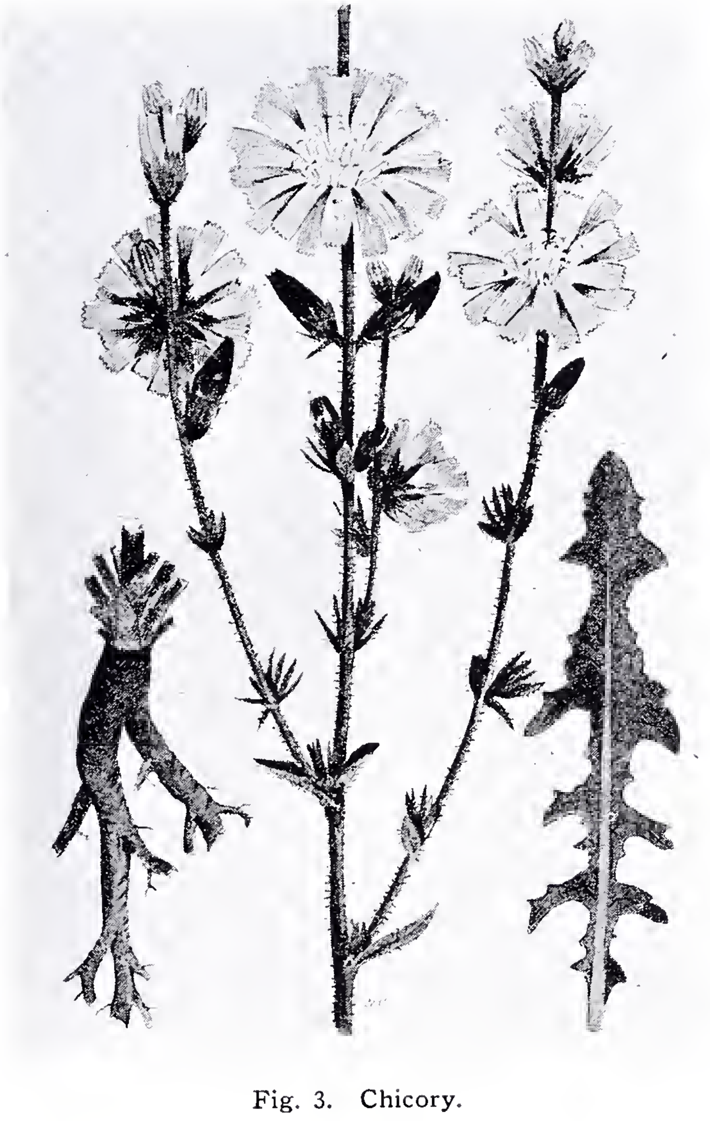

Fig. 3. Chicory.

FALSE FLAX

(*Camelina microcarpa* Andrz.)

There are two species of false flax. One is *Camelina sativa* (L.) Crants, which is glabrous or nearly so and whose seed pods are from one-fourth to one-third inch long. The other is *Camelina microcarpa* Andrz., which is somewhat hairy at least below, and whose pods are less than one-fourth inch long. This is the species more commonly found in Pennsylvania (Fig. 4).

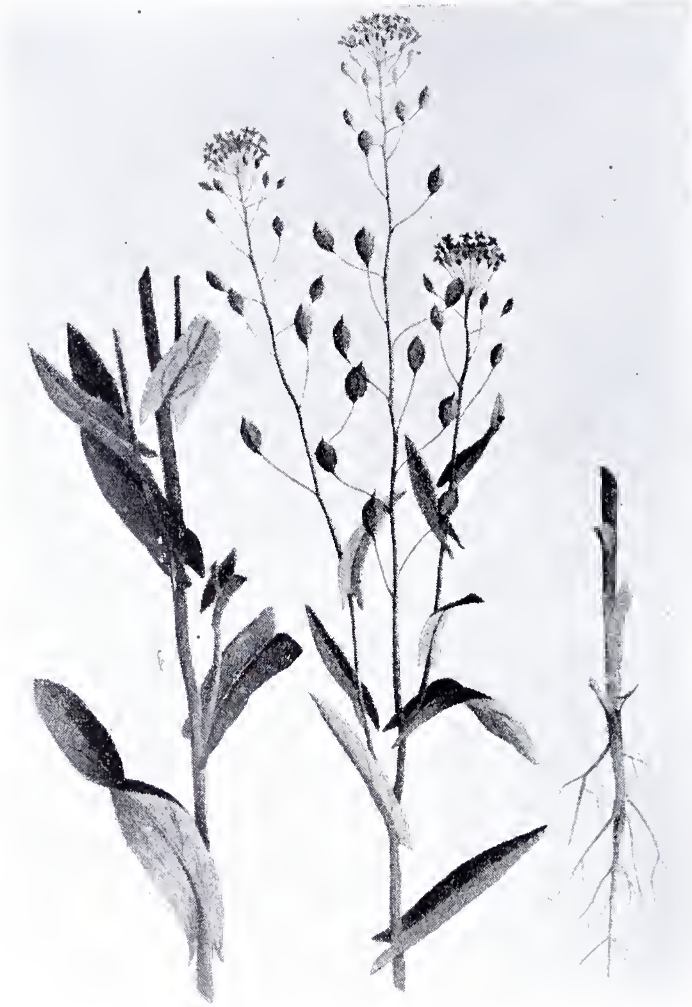

Fig. 4. False Flax.

Both species are annuals or winter annuals and are propagated only by seeds. They bloom from June to August and produce seeds from June to September. The plant has come to us from Europe where it is cultivated for the oil and mucilage in the seeds, both of which are similar to the products obtained from flax seed, from which it derives the name "false flax."

It is a widely distributed plant in Canada and the United States and is found growing in waste places, grain fields and in clover, alfalfa and grass fields. It is becoming a very serious pest in Pennsylvania and is causing the farmers of southeastern Pennsylvania considerable loss.

Recently, one farmer in Lehigh County lost a thirty-acre field of clover on account of this weed. The entire field was a perfect stand of the false flax—so bad that the farmer cut it early in June and left it lying on the ground to prevent it from seeding. Another farmer, in Chester County, cut his alfalfa prematurely in order to prevent the false flax from going to seed.

No doubt that the seeds of this weed were originally sowed by both farmers in their clover and alfalfa seed. Another illustration that farmers should take advantage of the protection offered by the Pennsylvania Seed Law, and that they should be particularly careful about sowing seed free from weed seeds.

Control and Eradication. Sow clean seed; and prevent seeding by clean cultivation, harrowing, hoeing, cutting and pulling plants before they seed or by any method possible. See that no seeds mature. The plant is too smooth to be controlled by spraying as can be done by some of the mustards whose stem and leaves are sufficiently hairy to hold the spray long enough to kill the plant.

FIELD PEPPER GRASS

(*Lepidium campestre* R. Br.)

Field pepper grass (Fig. 5) is an annual or winter annual which is propagated only by seeds. After flowering and seeding the entire plant, roots and all, dies. The seeds, however, may live for a long time in the soil.

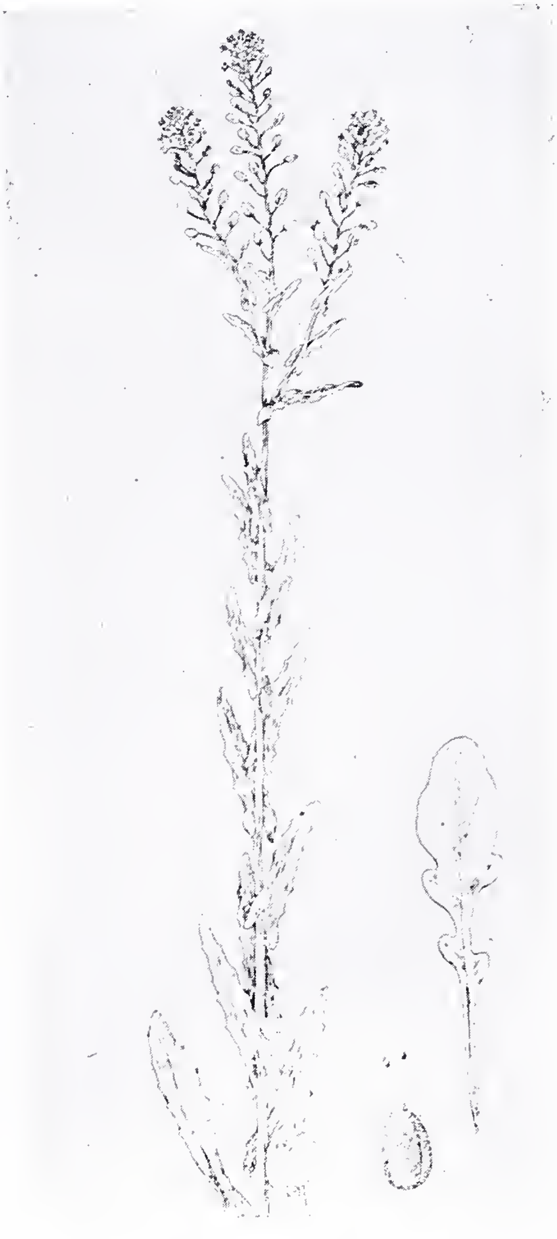

Fig. 5. Field Pepper Grass.

The plant begins to bloom in April and continues to bloom and produce seed until July. It comes to us from Europe and has spread over much of Canada and the United States. In southeastern Pennsylvania it is becoming a very troublesome weed. Some clover and grass fields contain almost a pure stand of this weed. Apparently farmers do not realize their great financial loss in allowing such a weed to become so abundant on their farms.

Control and Eradication. Sow clean seed. It is found in grass and clover seed. Since it is an annual or winter annual, being propagated only by seeds, it is very evident that the way to eradicate the weed is to prevent the maturing of seeds. The plant is very hairy and will hold spray material. It can, therefore, be controlled by spraying with a solution of iron sulfate (one hundred pounds dissolved in fifty gallons of water will spray an acre). This must be applied before or by the time it begins to bloom. Clean cultivation, cutting, pulling, hoeing or harrowing out young seedlings or anything that will keep the plant from maturing seeds will finally eradicate it.

HORSE NETTLE

(*Solanum Carolinense* L.)

Horse nettle (Fig. 6) is a very noxious perennial weed which is known locally by other names such as sand brier, bull nettle, apple of Sodom, tread softly, and other names.

The plant blooms from May to September, and forms mature seed from about July to November. It is propagated by seeds and by rootstocks. It has been said that the rootstocks will live for ten years under a pile of sawdust and will grow when the sawdust is removed.

Horse nettle has become common in Pennsylvania but is probably most abundant in the southeastern part of the State. It grows in almost any kind of soil and is found in meadows, cultivated fields and waste places.

Distinguishing Characters. The plant belongs to the potato family. The leaf, the white or light blue flower and the fruit resemble somewhat that of the potato plant or a small tomato. The marked distinction of the plant is the stout, sharp yellowish prickles found on the stems and veins of the leaf; also the rootstocks and the seed balls which are smooth, yellow and from one-half to three-fourths inch in diameter when ripe. The seeds in these balls are straw-colored, flat, round or egg-shaped and about one-tenth inch long.

Control. To destroy horse nettle, the roots must be starved out and seeds must not be allowed to form. All food that is found in the roots has been made by the leaves; therefore, keep the plant cut close to the ground so that no leaves will be allowed to grow. This will of course, prevent the plant from flowering and seeding. In pastures, if common table salt is added after cutting the plant, stock will seek the salt and thus assist in keeping the plant down. The salt itself will prevent the growth of leaves and the stem.

In cultivated fields, plant to tilled crops such as corn or potatoes. Plant in check rows if possible so that the field may be cross cultivated. Use the hoe to cut off plants not reached by the cultivator. Keep the plant down during the entire season even after cultivation stops. Remember that the primary object is to get rid of horse nettle, while raising a crop of corn or potatoes is secondary. Too often the farmer reverses these two objects and then wonders why he is not successful in eliminating a noxious weed. As soon as the corn is cut, disk or harrow the soil well, again using the hoe if necessary. Sow to rye. The following spring, if the horse nettle makes its appearance, plow the rye

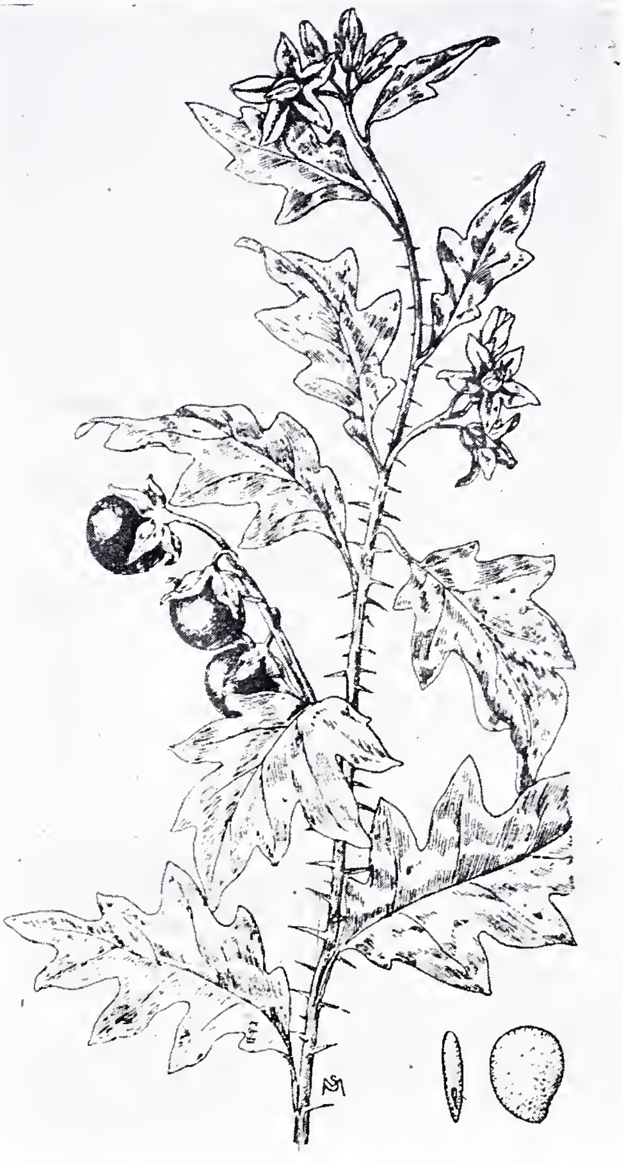

Fig. 6. Horse Nettle.

under and plant to corn the second year. If the work has been thoroughly done, certainly two seasons will eradicate the weed. A smother crop such as alfalfa, clover, vetch, millet or soy beans may follow the corn.

If a field becomes so badly infested with horse nettle or other noxious weeds that it is unprofitable to grow a crop of corn or potatoes, it may be necessary to summer fallow the field. In this case plow early in the spring and let it lie fallow during the summer. Cultivate every week or ten days so as to prevent any growth of weeds whatever. The following spring plant to corn or potatoes and proceed as stated above. Chlorates may be used in controlling this pest. See "Chemicals in Weed Control."

GARLIC

(*Allium* sp.)

Garlic (Fig. 7) is propagated by underground bulbs, aerial bulblets incorrectly called "seeds," and occasionally by true seeds which are very rarely produced. The underground bulbs consist of two kinds, the large, soft bulbs which are few in number, and the small hard bulbs which are more numerous. The large, soft bulbs usually sprout during the late summer and thus produce the crop of fall plants. The hard bulbs usually sprout the following spring although they may lie dormant for two or three years. The aerial bulblets sprout in the late summer, forming weak plants during the early fall.

Eradication. Garlic can be eradicated by a method of cultivation which must be followed with persistence. Three things are necessary:

1. Decide upon the method of procedure; 2. Thoroughness; 3. Persistence until 100 per cent of the plants are eradicated.

The following method, which has been used with success in several places is recommended:

1. Plow the ground late in the fall (November 15th or later) deep enough to cover completely the tips of the garlic plants. This plowing destroys the plants which have grown from the soft bulbs and the aerial bulblets. If the plowing is done late the strength of the bulbs is in the plant and the turning of the plant under will destroy the plant and the bulb, but if the plowing is done too early (before November 15th) the strength of the bulb has not yet ascended into the plant and the plant may continue to grow after the plowing is done, thus defeating the purpose of the fall plowing. If the tips of the garlic plants are not completely covered they may continue to grow after the plowing has been done, again defeating the purpose of the fall plowing. This fall plowing is a very essential part of the system of eradication and should be done with special care.

2. Early the following spring (April 1st to 15th) disc the ground thoroughly or plow again. This early spring cultivation will kill the plants that have started to grow from the hard bulbs. Many of the

hard bulbs will sprout during the summer, hence the necessity of thorough cultivation during the entire summer.

3. Plant, preferably in check rows, potatoes, corn or some crop that will admit of thorough cultivation throughout the summer. This summer tillage will destroy the plants that start to grow from the hard bulbs during the summer and by the end of the summer most of these hard bulbs will have sprouted and will have been destroyed. Some, however, may and likely will remain unsprouted; therefore, a repetition of the method a second and probably a third year will be necessary.

4. Repeat the process another season by plowing again in the late fall and the following spring. A different crop may be grown the second year. The crop should be such, however, as will admit of thorough cultivation. For instance: if corn has been grown the first season, potatoes or soy beans, planted in rows, may be used the second season. If the work has been thoroughly done the garlic may be entirely eradicated in two years. If it has not been eradicated, the process should be continued for a third and even a fourth year. The process should not be stopped until complete eradication is accomplished.

5. If the land is again used for the growing of wheat, be absolutely certain that pure seed is used.

6. The garlic that grows along the fence and in areas in the field that might not receive cultivation, such as ditches, must be eradicated at the same time that it is being eradicated from the field. This may be done by hand or by spraying.

7. Spraying with sodium chlorate is effective on small areas or in places that cannot be cultivated. Orchard heating oil or waste oil from tractors or automobiles may be used. If the waste oil is too thick and heavy to spray with an ordinary pressure sprayer or knapsack sprayer, it should be thinned by kerosene. Kerosene, however, is too light to do the work alone.

The spraying should be done just before the garlic forms heads, which is the latter part of April or during May. Another application may be made in the fall if necessary. The spraying should be continued for three years or until complete eradication is accomplished.

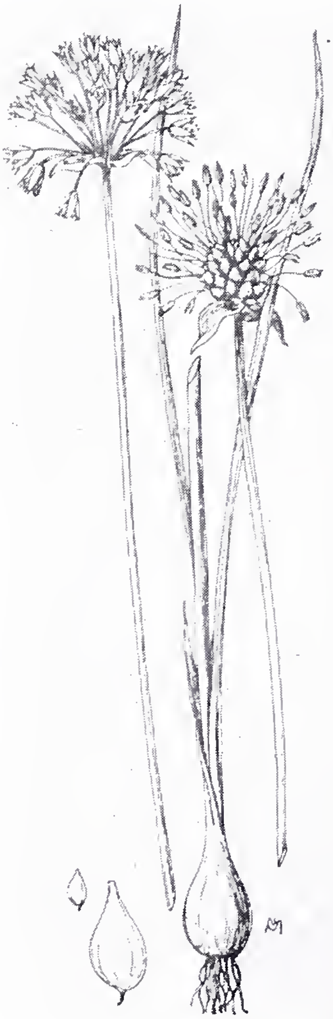

Fig. 7. Garlic.

Prevention. "An ounce of prevention is worth a pound of cure" is certainly true in reference to garlic.

1. Never sow seeds that contain garlic. Many farmers in Pennsylvania have not heeded this warning. The consequence is an annual loss to the State of $1,500,000 caused by garlic in wheat, regardless of any other loss which it may cause.

2. Manure that is suspected of containing garlic should be thoroughly composted for several months before being returned to the land.

3. The community thresher is one of the common agencies in the distribution of garlic. The greatest care should be exercised in threshing wheat that is to be used for seed.

4. Be vigilant—watch for garlic on waste places, along fences and ditches. Eradicate it on first appearance. Since garlic seldom produces seed it does not spread rapidly and its entrance and establishment may be prevented by vigilance.

Fig. 8. Winter Cress.

WINTER CRESS

(*Barbarea vulgaris* R. Br.)

Winter cress (Fig. 8) is an introduced perennial which is propogated by seeds. There are no rootstocks or runners of any kind which produce new plants. The cushion or rosette of green, shiny leaves is noticeable very early in the spring at which time the leaves make excellent greens. In Europe the plant is cultivated for use as a potherb. The flower stalks are one to two feet tall and begin to bloom in April and continue to bloom and form seeds for about three months. The flowers are bright yellow and about one-half inch in diameter.

The plant is found in grain fields, grass fields, gardens and waste places. It is widely distributed in Canada and the United States, and has become very annoying in parts of Pennsylvania. In the vicinity of Gettysburg in Adams County, the farmers are sustaining a great annual loss from the growth of this weed. Some of the grass fields and wheat fields have almost a perfect stand of this weed. On inquiry about the weed it was found that no concerted effort was made to eradicate or control it in that vicinity.

Many farmers complain about farm conditions and farm profits and still do not seem to realize that the loss of a wheat crop due to the growth of weeds is a great financial loss. They allow their yearly profit to be changed into a loss by the growth of a weed that can be controlled by sowing clean seed and by clean cultivation.

Prevention. Sow clean seed.

Eradication and Control. Since the plant is propagated only by seeds any method that will prevent seeding will eradicate the pest. Clean cultivation of such a crop as corn will destroy as much as ninety per cent of the plants in a polluted field. The other ten per cent should be destroyed before they produce seeds, by cutting, pulling, hoeing or any convenient method—but by all means prevent the maturing of seeds. Watch the waste places and fence rows. Cut the plants before they seed. Labor and expense are necessary to eradicate a weed when it becomes so abundant as winter cress has in some parts of Pennsylvania.

COCKLE

(*Agrostemma Githago* L.)

Cockle (Fig. 9) is a weed known by every farmer who has had any experience in the raising of wheat in Pennsylvania. It is primarily a weed of grain fields and as one writer has put it, "It is there because it is sown there." The farmers of Pennsylvania have been very careless and indifferent in the eradication of this plant.

"The seeds of cockle are poisonous, and when ground with wheat the flour is rendered unwholesome and even dangerous as food. Poultry and other animals have been killed when fed with screenings composed largely of seeds of cockle."

"A very little cockle is sufficient to cut the grade." The poisonous seeds and the lowering of the grade of wheat, regardless of other financial losses to the farmer, are sufficient reasons why farmers should eradicate this pest.

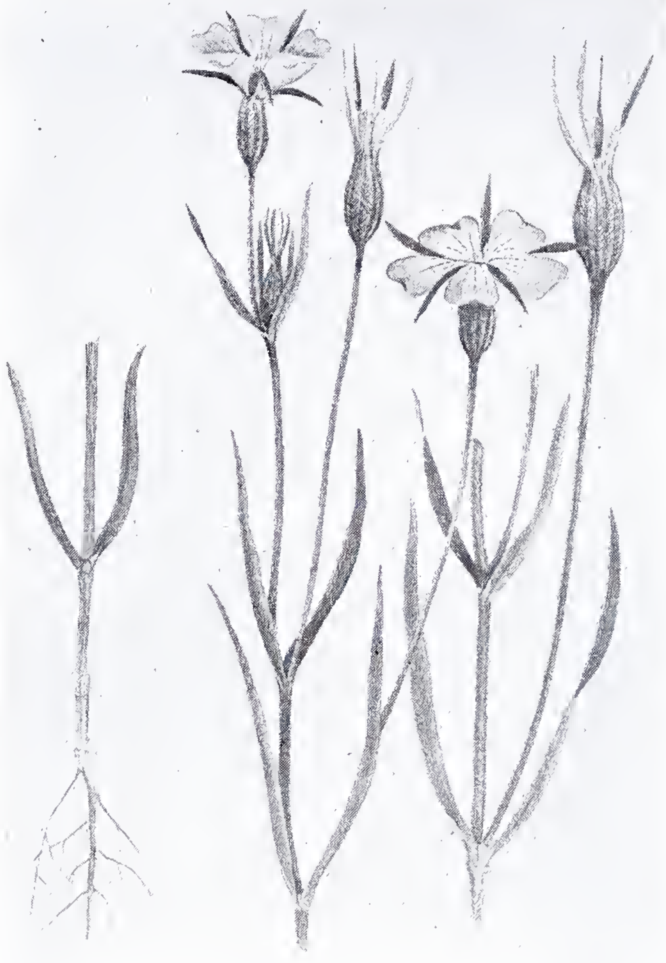

Fig. 9. Cockle.

Eradication and Control. Cockle is an annual and can be eradicated within a short time by sowing clean seed. Some seeds may live in the ground for several years, therefore, if the ground is known to be heavily infested with seeds of cockle, a cultivated crop, such as corn or potatoes, should be placed in the rotation. Sowing clean seed and the prevention of the maturing of cockle seeds will soon eliminate the weed from the farm.

PERENNIAL OR FIELD SOW THISTLE

(*Sonchus arvensis* L.)

There are three species of sow thistles: common sow thistle (*Sonchus oleraceus* L.); spiny-leaved sow thistle (*Sonchus asper* (L.) Hill); perennial or field sow thistle (*Sonchus arvensis* L.) (Fig. 10) The first two are annual plants and are propagated only by seeds. The third is a perennial which is propagated by seeds and by rootstocks. These rootstocks make it one of our very worst weeds.

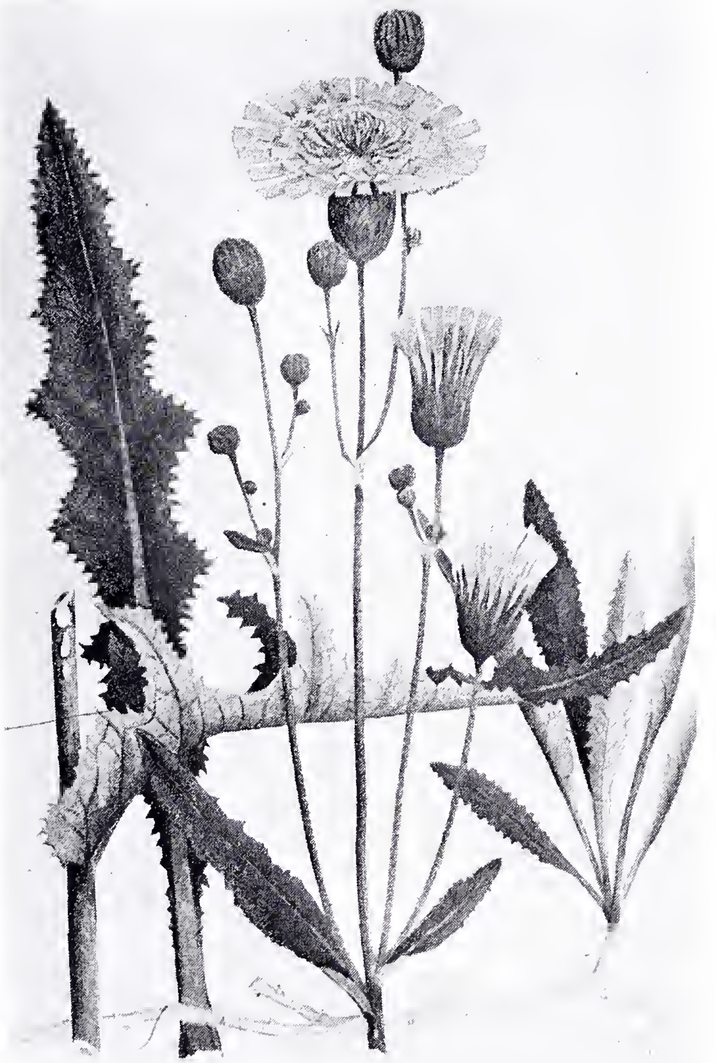

Fig. 10. Sow Thistle.

The sow thistles resemble wild lettuce plants in leaf and in their milky juice. The perennial sow thistle grows to a maximum height of about five feet. It bears a flower which looks almost like the dandelion flower. This pest is not common in Pennsylvania but is spreading and unless the farmers fight it, it will be in the class of Canada thistle, horse nettle, quack grass and other pernicious weeds. It has been found in Northampton, Montgomery, Dauphin, Erie and Huntingdon Counties, and can no doubt be found in nearly every county of the State.

Eradication and Control. Perennial sow thistle must be attacked in the same way that Canada thistle or any other noxious weed is attacked, namely: 1. Prevent seeding. The seeds are carried by the wind, hence it may spread rapidly in this way. 2. The rootstocks must be destroyed or starved out. In small patches, this may be done by digging the plants up and burning them, roots and all. If the patches are too large for this method, then follow the cultivated crop method or fallow method.

Plow the ground in the late summer or early fall. Harrow every week or ten days to keep down all weeds. Continue this until late fall. Begin again in the spring and prepare a good clean seed bed. Plant to potatoes or corn, or some crop that admits of clean cultivation. Remember that the destruction of sow thistle is the primary object. Use the hoe to kill any plants not reached by the cultivator. Don't stop cultivation after the corn is cut or the potatoes raised. Continue until late fall. If the weed is not killed, sow the field to rye. In the spring the rye may be plowed under and another crop of corn or potatoes planted. If the weed is under control, the rye may be cut. One year may eliminate the perennial sow thistle, but remember that a few plants left in the field will start a new colony. Don't stop the fight until 100 per cent of the pest is eradicated. Sodium chlorate is useful in controlling sow thistle.

QUACK GRASS

(*Agropyron repens* Beauv.)

Quack grass (Fig. 11) which is propagated by seeds and by perennial creeping rootstocks has become a common troublesome weed in Pennsylvania. It blooms during June and matures its seeds in July and September. It grows in any kind of soil but thrives best in rich, heavy soil. It may be found anywhere in the State in fields, roadsides and waste places. If it were not for its great power of spreading and crowding out other plants quack grass would be a useful plant. It makes good hay, good pasture and, on account of its matted roots, a splendid soil binder. In Europe the rootstocks are gathered, washed, cut into pieces about two-fifths of an inch in length and dried. They are sold to the drug trade as "dog grass" or "triticum" at a price ranging from three to seven cents a pound and are used in medicine for kidney and bladder trouble. Much of this is imported annually to the United States.

Distinguishing Characters. The chief distinguishing character is the pale yellow, smooth jointed rootstocks which are about one-eighth inch in diameter and run along just beneath the surface of the ground. These are so strong, sharp-pointed and unyielding that they have been known to push their way through potatoes. The plant grows from one to three feet tall and produces a spike which resembles a slender spike of wheat.

Eradication and Control. The creeping rootstocks must be killed. To do this prevent the growth of leaves. In cultivated fields, plow shallow in July or early fall. Harrow the ground to work the rootstocks free from the soil. Rake these together and burn or throw them in heaps and allow them to rot. Continue the harrowing until late fall frequently enough to prevent any growth of the grass. Begin cultivation as soon as possible in the spring. Continue until late corn planting time. Plant in corn, using the check row system if practicable. Cultivate the corn thoroughly during the season, using the hoe to prevent the growth of the quack grass not reached by the cultivator. As soon as

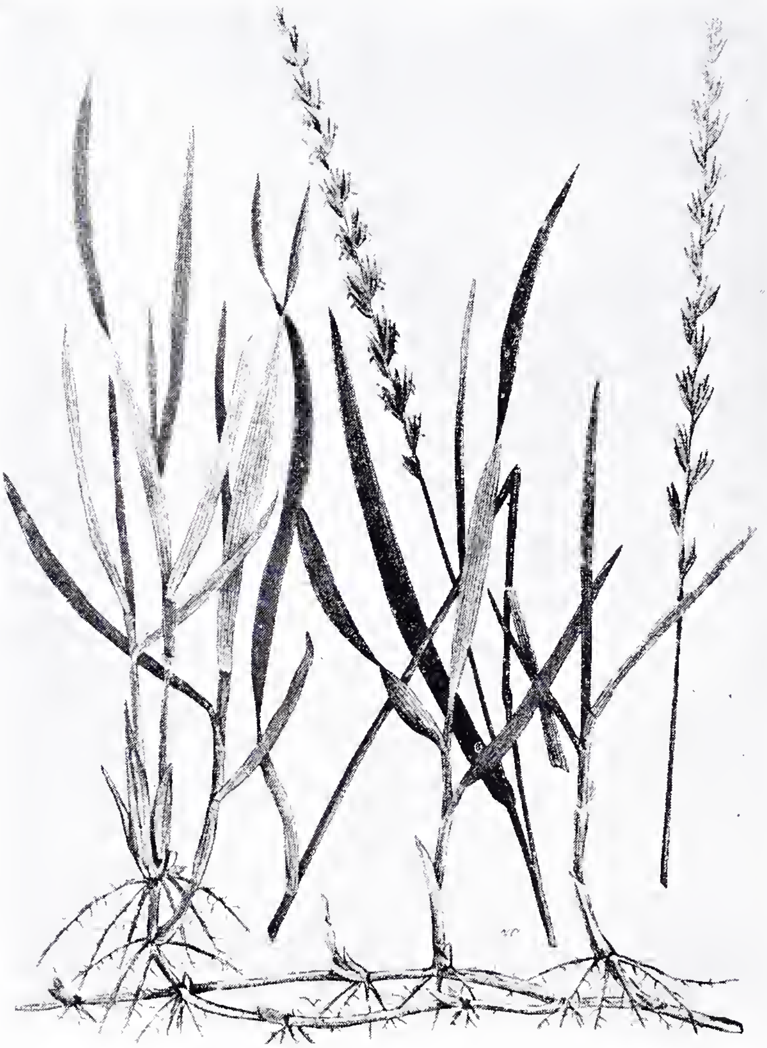

Fig. 11. Quack Grass.

the corn is cut begin cultivation again. Cultivate frequently enough to prevent the growth of any quack grass and thus prepare a good seed bed. Sow to rye. In the spring plow the rye under and prepare to plant to corn. Two years of such treatment should completely rid the field of quack grass. If necessary, however, the treatment should be continued for another year. The secret of success lies in keeping the grass subdued at all times. Never allow it to get the least start. Too many farmers in trying to kill quack grass as well as any other noxious weed, by the above treatment, give just enough tillage to keep it in a thrifty condition.

Small patches or areas may be killed out by smothering. This may be done by completely covering the area with boards or with tar paper held down by stones and pegs. A season of such treatment should kill the rootstocks. Sodium chlorate is effective in killing quack grass.

Hogs are very fond of the rootstocks, therefore by building a fence around small areas these animals may be used in the eradication of quack grass.

CLOVER DODDER

(*Cuscuta* sp.)

Dodder (Fig. 12) is a slender, twining parasitic plant. There are about fifty species found in America, about thirty-two of which are native. The farmer is interested only in those which attack his farm crops, such as clover and alfalfa.

Dodder reproduces from seeds. The seed germinates, producing a slender, yellowish shoot which twines about the clover or alfalfa plant. As soon as the dodder encircles the clover or alfalfa it begins to send tiny roots into the stem of the host plant. The soil roots of the dodder now die and it obtains its nourishment from the clover or alfalfa plant which is finally killed by the parasite. The dodder, however, does not die with the host plant but reaches out and becomes attached to a new host plant, thus extending in all directions without the formation of seeds.

Dodder is a very serious pest in Europe, many parts of which have laws prohibiting the sale of clover and alfalfa seed which contains a single seed of dodder; consequently a great deal of this seed has been sent to the United States. The dodder seed resembles that of clover and alfalfa and unless one learns to recognize its appearance it will pass unnoticed.

Control and Eradication. In small areas: Cut the patches with a scythe close to the ground. Allow the plants to dry, then burn. If kerosene or crude oil is applied before burning, the chances for killing any mature seeds that might have fallen out on the ground will be increased.

On areas too large for burning: If the dodder has not matured seed, the crop of clover with the dodder may be mowed and used for hay, or the plant may be kept down by grazing animals, or the entire crop, clover and all may be plowed under for a green manure crop. The mowing or plowing should be done early, keeping in mind the fact that dodder seeds germinate while in the milk or dough stage.

If the dodder has been allowed to go to seed the crop should be mowed and burned, as suggested for small areas. The field should then be used for a four or five year cropping system consisting of plants which are not attacked by the dodder, such as corn, potatoes, soy beans, cow peas, oats, wheat and rye. Rarely is it necessary in Pennsylvania to use the cropping system as suggested. Dodder can usually be eradicated by the methods suggested for small areas or for large areas when the dodder has not yet matured seeds. A three per cent solution of sulfuric acid has been successfully used in killing dodder.

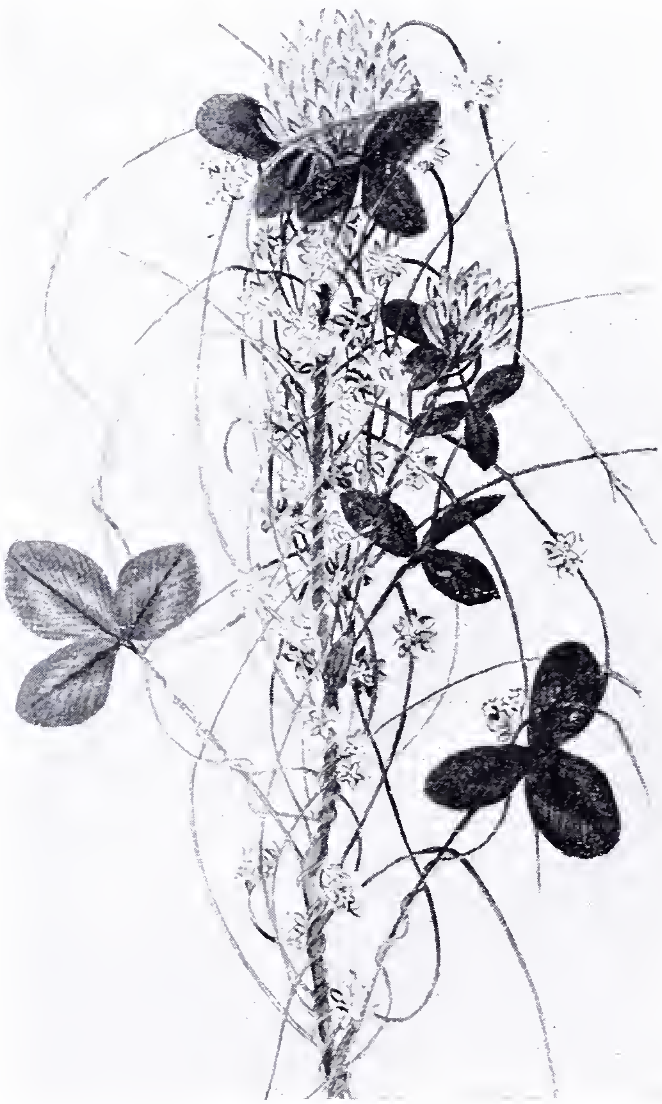

Fig. 12. Clover Dodder.

MORNING GLORY

(*Ipomoca* sp.)[1]

Wild morning glory is a difficult plant to eradicate. If the plant did not twine around the corn, this would be a good crop to grow in order to eradicate the pest, due to the fact that it admits of clean cultivation. The roots of the morning glory may be starved by keeping the plant cut close to the ground. This must be done often and constantly as long as the stem and leaves continue to come up. If done thoroughly, a season may accomplish the result but two would more likely be required. In order to keep the leaves and stem cut down, the ground must lie fallow or some crop such as potatoes which admit of clean cultivation, may be grown. If there are only small patches to kill, these patches may be

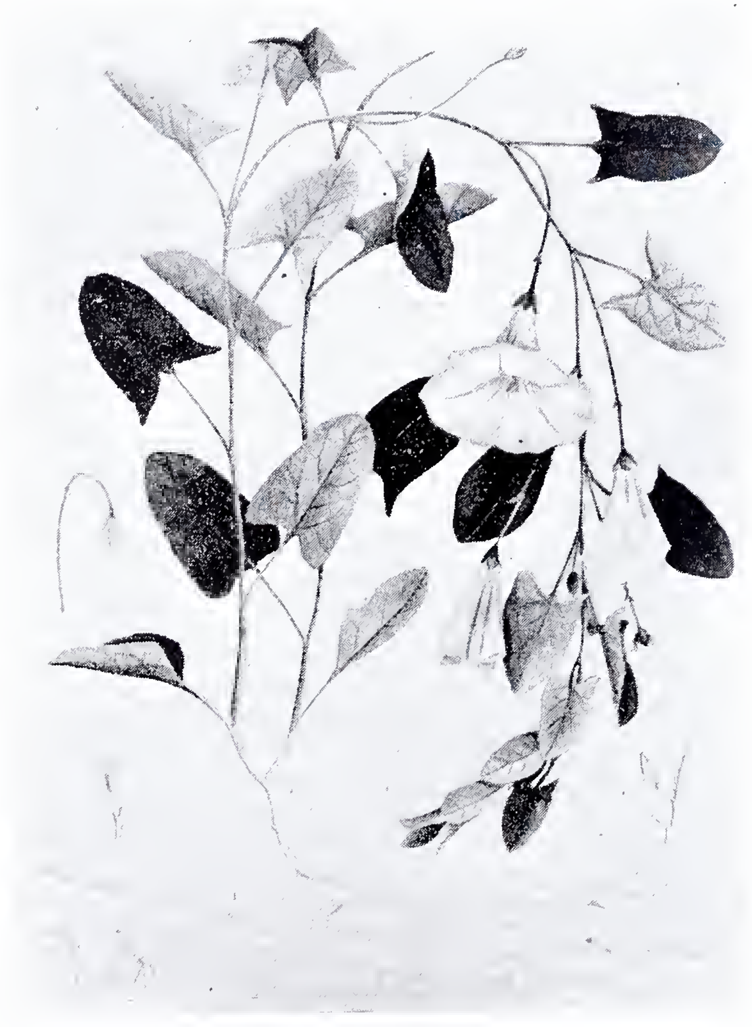

Fig. 13. Field Bindweed.

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[1] Bindweed (Fig. 13) is similar to morning glory and can be controlled in like manner.

plowed and allowed to lie fallow during the summer, cutting the plant every week or as often as needed with a broad hoe.

If the area is extensive the same method may be used and the weed kept down by cultivation with a knife or sweep form of cultivator. This method should be used until the plant is absolutely exterminated. If it is not entirely eradicated it will give trouble again in a few years. Many farmers stop fighting too soon. When they have killed ninety per cent of the weed they forget about it and allow the remaining ten per cent to start further trouble. Any weed may be eradicated by the above method if the method is continued long enough. The very fact that ninety per cent of the weed was destroyed in one or two seasons shows that the method is effective.

The following is quoted from "Weeds of California."

"Mr. S. S. Rogers, a vegetable grower of Yolo County, has had considerable experience with the control of morning glory in the vegetable fields. He succeeded in eradicating it by the following method:

"A crop of garden peas was grown during the winter of 1915 and harvested during the following May. The soil was dry-plowed to a depth of about eight inches immediately after harvest and replowed at intervals of about three weeks during the summer until the first frost of fall. Between plowings the land was cultivated regularly once a week. A crop of cabbage was then planted and grown during the winter, and harvested the following June, after which the soil was treated as the preceding year. Although the field was practically a solid mass of morning glory at the start of the work it was so completely eradicated by this two years' treatment that it has never appeared since. This work was done several years ago, therefore, it is safe to presume that there will be no further trouble in this particular field again."

"Three years ago the Trafton ranch, in Mud Flat, Pajaro Valley, undertook to clean up a dense infestation of morning glory after taking off a grain crop in June. The grain crop dried the land thoroughly, but it was plowed, clods crushed, harrowed several times, and then weed cutters were set to work. The cultivators were arranged to cut about three inches deep and run over the land every five days till frost came to stop growth. Potatoes were planted the season following, and when the potatoes were cultivated almost no morning glory was to be found, very few plants appearing during the season."

Small patches can be destroyed by the application of sodium chlorate.

HAWKWEEDS

(*Hieracium* spp.)

The troublesome species of hawkweeds are: Orange hawkweed (*Hieracium aurantiacum* L.) also called devil's paint brush, devil's weed and red daisy (Fig. 14), and field hawkweed (*Hieracium pratense* Tausch.) also called king devil and yellow devil. These are both introduced perennial plants which are propagated by seeds, by roots, and by stolons or runners.

New plants originate from the slender fibrous roots of the parent plants. Runners originate at the base of the plant and run out on the top of the ground in all directions from the parent plant. These runners

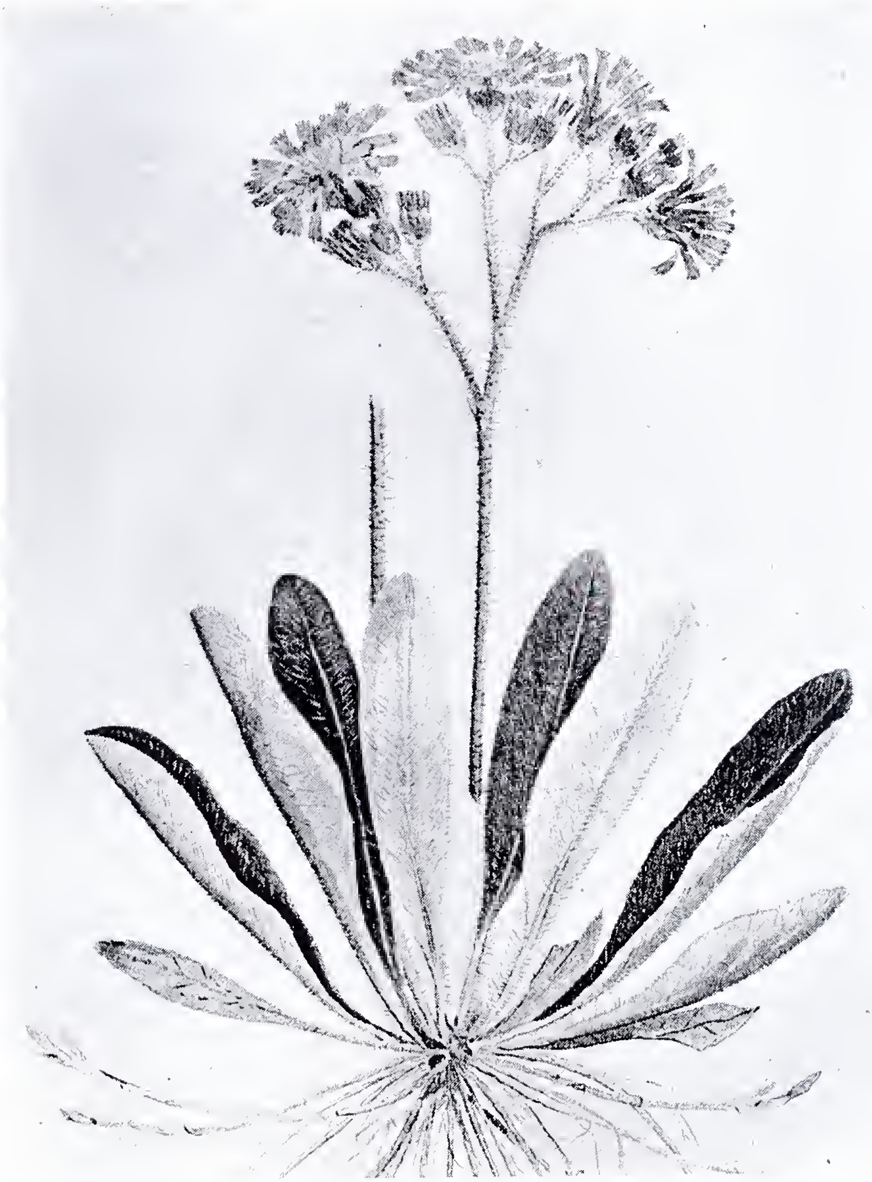

Fig. 14. Devil's Paint Brush.

take root and produce new plants. Very few weeds of any kind are reproduced by both roots and stolons. If stolons are present new plants will not spring from the roots, or if the roots originate new plants the stolons are not present, but here we have both of these methods of propagation and in addition the plant produces an abundance of seeds.

Eradication and Control. This habit of the hawkweeds makes them difficult to eradicate. Keeping the plant from going to seed will not exterminate it because new plants are constantly being produced by the other two methods of propagation. Therefore, to eradicate the hawkweeds, roots and stolons must be destroyed and seeds must not be allowed to mature. In fields that admit of cultivation, such a crop as corn or potatoes may be grown. Plants that cannot be reached by the cultivator should be kept cut close to the ground with a hoe.

If one season does not eradicate the weed, the ground may be carefully prepared for rye after the corn has been cut or the potatoes raised. The rye may be plowed under the following spring and another crop of potatoes or corn planted. If the work has been carefully done the weed will be eradicated or at least under control.

Small patches may be killed by a heavy application of common table salt or sodium chlorate, or they may be smothered out by covering with tar paper, tin roofing or anything which will completely exclude the light. Small patches may also be dug up, and the removed plants, roots and all, burned. Don't stop the work until 100 per cent of the plants are eradicated. One per cent left in the ground will start it anew.

OX-EYE DAISY

(*Chrysanthemum leucanthemum* L.)

The ox-eye daisy (Fig. 15) is known by a number of common names; among these are white daisy, poverty weed, field daisy and poorland flower. As is the case with many of the pernicious weeds, it comes to us from Europe. While the roots are perennial the plant does not spread from the roots like Canada thistle, quack grass and some other more noxious weeds but is propagated entirely by seeds which are found as impurities in many grass seeds.

Distinguishing Characteristics. Nearly everybody knows the ox-eye daisy but those who do not may recognize it by its beautiful flowers with yellow centers surrounded by white rays which number from twenty to thirty. The stem of the plant is from one to three feet tall often growing in tufts or bunches. The leaves are toothed, cut or divided. Indeed the ox-eye daisy when in bloom is beautiful and may well be used for decorative purposes which may be one of its redeeming features.

Eradication and Control. The ox-eye daisy spreads only by seeds which are produced in abundance, and while the plant has perennial roots it yields very readily to cultivation. The first consideration to be given to it is to prevent the maturing of seeds. A field of daisies may be almost completely destroyed in one year by clean cultivation of such a crop as corn or potatoes. Of course the plant must be cut so as not to mature seeds along the fences, and road sides and in adjoining fields. This is, indeed, no easy task since the plant is so widely distributed and since it will grow in almost any kind of soil conditions. The eradication of ox-eye daisy as well as any other pest, whether plant or animal, should be made a community problem and everybody in the community should do his bit in eradicating it. Alternation of crops, cutting plants in waste places so as to prevent seeding, the sowing of clean seeds, and persistent vigilance will clean up the ox-eye daisy.

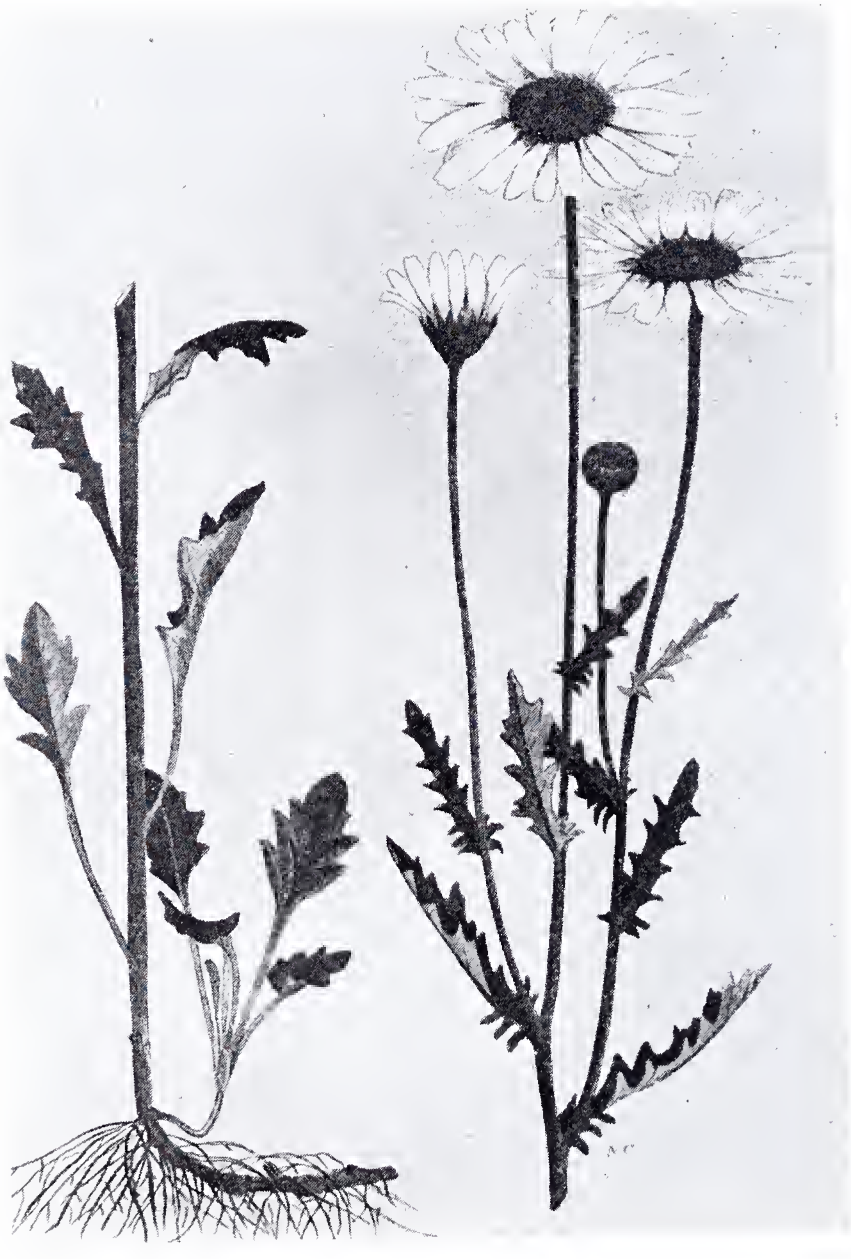

Fig. 15. Ox-eye Daisy.

WILD CARROT OR QUEEN ANNE'S LACE

(*Daucus carota* L.)

If beauty and delicacy decided the popularity of a plant, perhaps the wild carrot (see cover page) would be classed among the most popular garden flowers; but like the daisy and many other plants it is too common and too annoying to the farmers to be called anything but a weed.

Distinguishing Characteristics. The stem of the wild carrot is hollow and ranges from about one to four feet high. The leaves are cut and divided so that they resemble the delicate, filmy fronds of some ferns. The flowers are borne in white flat-top clusters. Each cluster, which is called umbel, is made up of a great many small, white flowers. These tiny flowers give to the cluster a filmy, lace-like appearance which wins for the plant its name "Queen Anne's Lace." When these clusters are mature they curl up at the edges giving them the shape of a small bird's nest which give the plant another of its common names, "Bird's Nest Plant."

This nest-shaped cluster prevents all the seeds from dropping at once. As the wind sways the plant a few seeds are shaken out and scattered about. Some of the seeds are retained in the bird's nest for quite a long time; perhaps some of them remain there until winter, when the seeds will be carried still farther in the drafting snow or over its hard, slippery crust.

The roots of the wild carrot are biennial. The seeds germinate and produce in the first season roots and a rosette or cushion of leaves close to the surface of the ground. These leaves make food and store it in the rather thick, carrot-like root, but no stem, flowers or seeds are produced during this first season. This thick, fleshy root lives over winter, like the cultivated carrot, and sends up a stem the following season which bears flowers and seeds. At the end of the second season the entire plant, including the roots, dies. The seed is the only remaining living part of the plant.

Eradication and Control. Since the plant is a biennial it is evident that it can be controlled by preventing the maturing of seeds. This must be done not only in the field but along the fence, and the road side, and in adjoining fields. The eradication of wild carrot is not so difficult as that of plants with a perennial root like Canada thistle, quack grass and horse nettle. However, one must be vigilant and not allow the production of seeds. One plant produces a great many seeds and may be the means of polluting an entire farm within a very few years.

A field of wild carrot may be almost completely destroyed by growing a cultivated crop such as corn or potatoes for only one year. Some seeds may, of course, remain in the soil for several years. These will produce new plants later, that must be destroyed before they produce seeds. A farmer wishing to rid his farm of wild carrot or any other weed must, of course, see to it that clean seeds are sown.

WILD MUSTARD

(*Brassica* spp.)

Elsewhere in this bulletin, false flax, field pepper grass, and winter cress are discussed. These all belong to the mustard family, which includes also several other weeds which are becoming very serious pests throughout the State. Among these are Charlock or wild mustard (*Brassica arvensis* Ktze.) (See Fig. 16), black mustard (*Brassica nigra* L.), wild radish (*Raphanus raphanistrum* L.), and tumbling mustard (*Sisymbrium altissimum* L.). These are all annuals or biennials and have the characteristic yellow mustard flower, except the wild radish which has a flower with pale yellow or white petals streaked with purple veins.

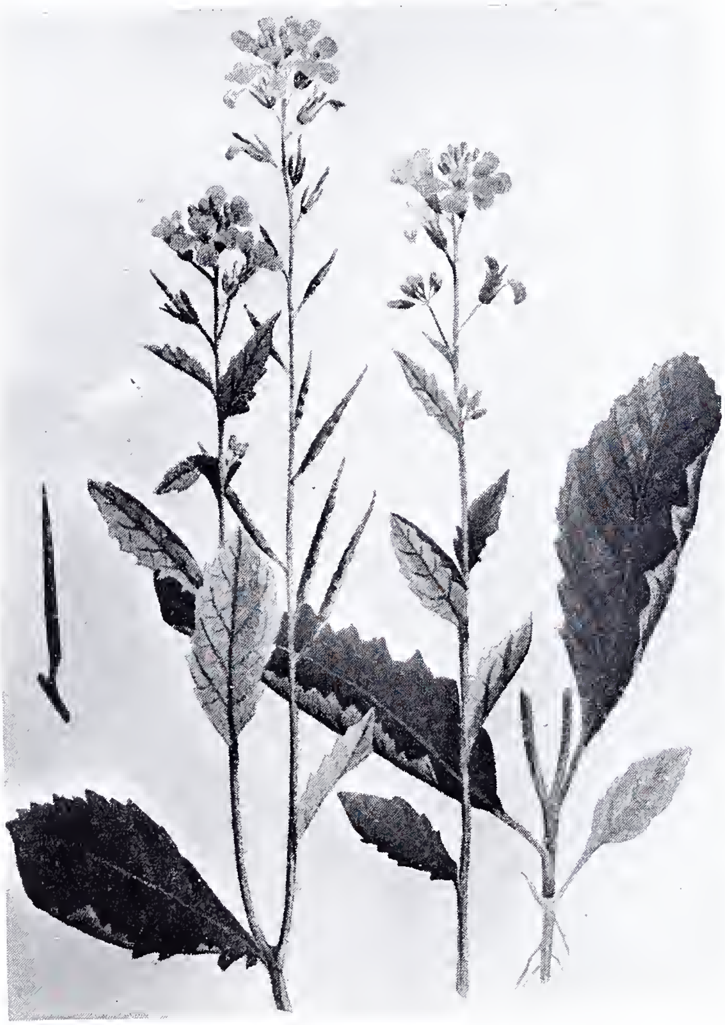

Fig. 16. Wild Mustard.

Eradication and Control. These weeds are all annuals or biennials and are propagated only by seeds which are produced in great abundance and which retain their vitality for a long time in the soil. By experiment, black mustard seeds are known to have germinated after being buried in the soil for twenty-five years. They may be deeply buried for years and when brought close to the surface where germination conditions are favorable may begin to grow.

Mustards are propagated only by seeds, so that the seeds must not be allowed to mature. Plants must be destroyed when or before they begin to bloom. The mustards, as well as many other weeds, begin to bloom early and continue for a long time. Mature seeds can be found on the lower part of the flowering stem, while open flowers and buds may be found above.

In Pennsylvania, mustard very frequently is obtained in oats. Some farmers refuse to pay the extra price of forty or fifty cents per bushel for seed oats, and instead sow feed oats which contain mustard seeds. It is not difficult to screen out the mustard seed. This has usually been done with the seed oats but not with the feed oats. The short-sighted farmer saves a few dollars by seeding feed oats but taxes heavily the future by introducing mustard and perhaps horse nettle, Canada thistle, and quack grass, as well as other serious weeds.

Therefore, in the control of mustard, as well as of all other weeds, first of all sow only clean seed.

To eradicate mustard when once established is by far more difficult than to prevent its appearance. Those mustards whose stem and leaves are hairy can be killed by spraying with iron sulfate or copper sulfate. This must be done while the plants are tender, which is before or by the time they begin to bloom.

Neither of the above sprays will damage grass or grain if applied before they begin to head; but the mustard plants, if young, tender, and hairy, are very susceptible. The spray must be in a fine mist; large drops will roll off the leaves like rain and, of course, will not be effective. The spraying should be done when the plants are not likely to be rain-washed for a day or two. See "Chemicals in Weed Control."

If the mustard plants are smooth, like those of tumbling mustard, the spray will not stick sufficiently to kill them. In this case eradication and control must be accomplished by hand or by cultivation. Clean cultivation of such a crop as potatoes or corn will eradicate the plant, but, of course, will not destroy the live seeds which may still be in the soil. Extreme vigilance and care for several years will be necessary for complete extermination.

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